CLAIMS

1. An integrated optical waveguide having an in-line light sensor integrally formed therewith, comprising: a first part of the waveguide leading to a photodiode portion thereof; a second part of the waveguide leading away from the photodiode portion, the photodiode portion comprising one or more regions of light absorbing material within the waveguide arranged to absorb a minor proportion of light of one or more selected wavelengths transmitted along the waveguide and thereby to generate free charge carriers within the waveguide; and detecting means for detecting the presence of said free charge carriers.

2. A waveguide as claimed in claim 1 in which the material from which the waveguide is formed has an energy band gap the magnitude of which corresponds to absorption of photons of a first wavelength, the photodiode portion thereof being modified to introduce deep band gap levels therein so as to provide at least partial absorption of photons of an optical signal of a selected wavelength or wavelength band greater than said first wavelength.

3. A photodiode as claimed in Claim 1 or 2 in which the modification comprises the presence of defects in the intrinsic region.

4. A photodiode as claimed in Claim 3 in which the defects comprise defects in the crystalline structure of the photodiode portion.

5. A photodiode as claimed in Claim 3 or 4 in which the defects comprise elemental impurities within the photodiode portion.

6. A waveguide as claimed in claim 3, 4 or 5 in which the deep band gap states are formed by ion implantation.

7. A waveguide as claimed in claims 4 and 6 in which the defects are formed by hydrogen (proton) implantation.

8. A waveguide as claimed in any preceding claim in which the detecting means comprises a diode.

9. A waveguide as claimed in claim 8 in which the diode is a p-i-n diode comprising a p-doped region, and an n-doped region in electrical contact with a nominally intrinsic region, the nominally intrinsic region being located so the majority of light transmitted along the waveguide passes therethrough.

10. A waveguide as claimed in claim 9 in which the nominally intrinsic region is relatively lightly doped with p-dopant adjacent said p-doped region and n-dopant adjacent said n-doped region.

11. A waveguide as claimed in claim 9 or 10 in which the p-i-n diode is a lateral p-i-n diode.

12. A waveguide as claimed in claim 9 or 10 in which the p-i-n diode is a vertical p-i-n diode.

13. A waveguide as claimed in any preceding claim which is a rib waveguide comprising a rib projecting from a slab region.

14. A waveguide as claimed in claims 9 and 13 in which the p-and n-doped regions are formed on opposite sides of the rib waveguide.

15. A photodiode as claimed in Claim 9 and 13 in which the p-doped region is formed on one side or both sides of the rib waveguide and the n-doped region on top of the rib waveguide, or vice versa.

16. A waveguide as claimed in claim 14 or 15 in which the p-doped and/or n-doped regions are formed at the base of one or more recesses formed in the slab region.

17. A waveguide as claimed in claim 13 in which said photodiode portion is, at least partially, within the rib of the rib waveguide.

18. A waveguide as claimed in any preceding claim in which the refractive index of the material thereof and/or the dimensions thereof are selected so as to provide similar confinement factors for both the TE and TM modes whereby the detection of light thereby is substantially polarisation independent.

19. A waveguide as claimed in any preceding claim which is formed of silicon.

20. A waveguide as claimed in Claim 19 formed on a silicon-on-insulator chip.

21. A waveguide as claimed in any preceding claim in which the selected wavelength band is around 1.3 or 1.5 microns.

22. A method of fabricating a waveguide as claimed in claim 1 in which the photodiode portion and the detecting means are fabricated by one or more of the following: lithographic techniques, doping and ion implantation.

23. A method as claimed in claim 22 in which the material from which the waveguide is formed has an energy band gap the magnitude of which corresponds to absorption of photons of a first wavelength and the photodiode portion thereof is modified to introduce deep band gap levels therein so as to provide at least partial absorptions of photons of a selected wavelength or wavelength band greater than said first wavelength.

24. A method as claimed in Claim 23 in which the modification is by ion implantation.

25. A method as claimed in Claim 24 in which one or more of the following species is implanted: gold, oxygen, germanium, carbon, hydrogen, helium, and silicon atoms or ions.

26. A waveguide as claimed in any preceding claim having wavelength selective reflector means being arranged to reflect light of said selected wavelength or range of wavelengths so it passes repeatedly through the photodiode.

27. A waveguide as claimed in claim 26 in which the reflective means comprises first and second reflectors.

28. A waveguide as claimed in claim 27 in which the first and second reflectors are provided in the first and second parts of the waveguide on opposite sides of the diode portion.

29. A waveguide as claimed in claim 27 or 28 in which at least one of the first and second reflectors comprises a Bragg grating.

30. A waveguide as claimed in any of claims 26 - 29 in which the in-line light sensor is tuneable so as to be sensitive to one or more selected wavelengths or wavelength bands.

31. A waveguide as claimed in claim 30 in which first wavelength control means are provided to adjust the wavelength or band of wavelengths reflected by the reflector means.

32. A waveguide as claimed in claim 30 or 31 in which second wavelength control means are provided to adjust the wavelength or band of wavelengths absorbed within the diode portion.

33. A waveguide as claimed in claim 30, 31 or 32 in which the in-line light sensor can be scanned over a range of wavelengths to provide a spectral analysis of the light received.

34. A waveguide as claimed in any preceding claim comprising an optical attenuator for attenuating the light passing through the in-line light sensor.

35. A waveguide as claimed in claim 34 in which said attenuator is a variable optical attenuator.

36. A waveguide as claimed in any preceding claim having two or more in-line light sensors arranged in series or in parallel.

37. A waveguide as claimed in claim 36 in which each in-line light sensor is arranged to be sensitive to a different wavelength or wavelength band.

38. A waveguide as claimed in claim 36 or 37 arranged in series along a substantially straight light conductive path.

39. A waveguide as claimed in claim 36 or 37 arranged in series along a serpentine light conductive path.

40. A waveguide as claimed in claim 39 formed on a substrate, said substrate having optical and/or electrical isolation devices formed therein positioned so as to assist in

optically and/or electrically isolating different portions of said serpentine path from each other.

41. A waveguide as claimed in any of claims 36-40 each having a variable optical attenuator in series therewith.

42. A waveguide as claimed in any of claims 36-41 arranged to form an optical channel monitor for monitoring the individual channels of a multi-wavelength optical signal.

43. An integrated optical waveguide having an in-line light sensor integrally formed thereon with the light sensor comprising a p-i-n diode formed in a semiconductor substrate having an energy band gap the magnitude of which corresponds to absorption of photons of a first wavelength, the photodiode comprising a substantially intrinsic region in said semiconductor substrate between p- and n-doped regions, the intrinsic region being modified to introduce deep band gap levels therein so as to provide at least partial absorption of photons of an optical signal of a selected wavelength or wavelength band greater than said first wavelength and thus generate an electrical signal across the p-i-n diode indicative of said optical signal, said photodiode being provided within a resonant cavity.